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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

March 12 - March 18, 1999

Summary 99-11

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EVENTS

1. POWER FEED ELECTRICAL SHORT

On March 9, 1999, an electrical and instrumentation (E&I) mechanic at the Savannah River Vitrification Facility inadvertently placed an energized 480-V electrical cable on top of an exposed panel heater while he was troubleshooting an electrical problem with a well-water pump. The purpose of the panel heater is to maintain low humidity inside a local control station panel. The heating element melted the cable and caused a direct phase-to-ground short circuit. The short blew a fuse, interrupting power to the affected cable. Workers were wearing the protective equipment required by the work plan in effect, and no worker was within 2 feet of the panel when the short occurred. Although no personnel injuries occurred, the event compromised worker safety. (ORPS Report SR--WSRC-WVIT-1999-0007)

The well-water pump had not performed satisfactorily following corrective maintenance. E&I mechanics had obtained troubleshooting instructions and authorization to use a nondocumented lockout to identify the cause. A nondocumented lockout relaxes some of the documentation and review requirements of a standard lockout under certain well-defined conditions. An E&I mechanic de-energized primary power to the pump and began lifting the pump motor leads at the local control station panel. At one point, access to terminal connections required him to relocate some energized power feed cables that were close to a panel heater, but he did not notice that one of them had contacted the heater. He heard a noise and backed away from the panel.

The facility manager held a critique of the occurrence and initiated an investigation. Participants in the critique determined that either a guard around the heater or closer attention to detail would have prevented the occurrence. However, they also determined that the presence of multiple energy sources inside the panel, without physical separation through permanent shielding, precluded the use of a nondocumented lockout. A separate electrical circuit powers the panel heater. The facility manager suspended all further use of nondocumented lockouts pending a complete review of this occurrence.

NFS reported a similar occurrence in Weekly Summary 97-31. A subcontractor electrician at Savannah River used a nondocumented lockout/tagout to lock out a cabinet that had more than one electrical feed. He installed the lockout to de-energize a 480-V electrical source while troubleshooting and repairing a laboratory heating, ventilation, and air conditioning system. While the electrician was working on the system, an auditor discovered that the cabinet contained an energized 120-V electrical feed in addition to the 480-V source. A documented lockout should have been used because there was more than one source of electrical energy inside the cabinet. (ORPS Report SR--WSRC-TNX-1997-0005)

These events underscore the need for strict adherence to lockout/tagout requirements. Personnel who prepare lockouts/tagouts must completely understand lockout requests and ensure that the lockout/tagout addresses all isolation boundaries. DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, states that every isolation from an energy source must be verified. The initial verification should include a review of pertinent controlled drawings or manuals and a hands-on check of the equipment to help identify obscure sources of power.

OSHA Standard 10 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*, requires an energy control procedure to protect employees during servicing and maintenance. The intent of the standard is for employers to develop a unique procedure for each different maintenance or service operation where protection from hazardous energy is required. Section (c)(4)(1) of the standard provides an exception: the employer need not document the required procedure for a particular machine or equipment when all of the following conditions are met.

- The machine or equipment has no potential for stored or residual energy or the re-accumulation of stored energy after shutdown that could endanger employees.
- The machine or equipment has a single energy source that can be readily identified and isolated.
- The isolation and locking out of the single energy source will completely de-energize and deactivate the machine or equipment.
- The machine or equipment is isolated from the energy source and locked out during servicing or maintenance.
- A single lockout device will achieve a locked-out condition.
- The lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance.
- The servicing or maintenance does not create hazards for other employees.
- The employer, while using this exception, has had no accidents involving the unexpected activation or re-energization of the machine or equipment during servicing or maintenance.

This exception, which is repeated in section 4.1.4 of DOE-STD-1030-96, has the effect of streamlining the lockout/tagout process for qualified operations and equipment. However, it bypasses the judgment and experience of personnel who would otherwise review and approve a documented lockout/tagout plan or procedure. Site and facility managers who use the exception must ensure that administrative and implementing procedures clearly set forth the foregoing conditions and the approved methods for implementing them. They must also ensure that personnel who implement the exception are fully qualified by training and experience to do so.

Facility managers should review DOE/EH-0540, Safety Notice 96-05, "Lockout/Tagout Programs." The notice summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements. Safety Notice 96-05 can be obtained by writing to the ES&H Information Center, U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available on the OEAF home page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: lockout and tagout, electrical maintenance, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Work Planning

2. WORK CONTROL VIOLATIONS RESULT IN SUBCONTRACTOR NEAR MISS

On March 10, 1999, at the Rocky Flats Environmental Technology Site, subcontractor electricians caused a 480-V electrical arc when they attempted to measure voltage in an electrical panel while their meter was set to measure amperage. In addition, they continued to work after the arc occurred and after construction oversight personnel had told them several times to stop work. The subcontractor electricians had been directed to visually inspect a battery charging station but were not authorized to perform work. In addition, one of the electricians stepped into a designated radiological contamination area without his thermoluminescent detector or without signing on a radiological work permit. Because of this and other related events, the chief operations officer and the deputy general manager suspended all third-tier subcontractor construction/field work until subcontractor personnel are all retrained on basic compliance issues. (ORPS Report RFO--KHLL-D&DOPS-1999-0001)

Investigators determined that construction personnel were removing waste crates from a building during decontamination and decommissioning activities when a battery for a fork truck they were using failed. Because they were unable to recharge the battery using the building charging station, they asked the subcontractor electricians to inspect it. The electricians attended a preevolution brief before performing the inspection. While inspecting the charging station they discovered an open 480-V panel and attempted to measure the voltage in it, causing the arc. Quality assurance personnel observed the arc and contacted construction oversight personnel, who directed the electricians to stop work. The electricians continued to work on the panel because they believed it was in an unsafe configuration, and the construction oversight personnel directed them for a second time to stop work. Again, the electricians continued to work. They were repairing an interlock to allow closure of the panel door when construction oversight personnel directed them to stop work immediately. In addition, after the second stop-work order had been issued, one of the electricians continued to perform a walk-down of the charging station cable and stepped over a yellow and magenta rope and into a designated radiological contamination area. Quality assurance personnel observed the boundary breach, ordered the electrician to stand still, and summoned a radiological control technician. The technician determined that he would need to survey the electrician and went to obtain a surveying meter. The electrician attempted to follow him, and quality assurance personnel directed him for a second time to stop and stand still.

The facility manager held a fact-finding meeting on this event. Meeting attendees identified several work control issues that were involved in this event. The facility manager directed facility personnel to perform an area walk-down to identify and correct safety or electrical system problems. He also directed them to complete the following corrective actions.

- Ensure that subcontractors do not perform work on equipment belonging to Rocky Flats.
- Revise preevolution briefing forms to include verification that personnel performing work either are escorted or have received building indoctrination.
- Erect an accountability board at the job site and include a sign in/sign out log.
- Include the following information in preevolution briefings: (1) everyone has stop work authority, and workers must stop when directed to do so, (2) ensure workers are knowledgeable about the supervision at the job site, and (3) workers must notify supervisors if job conditions change or are different from what was expected.

- Ensure that adequate supervision is present at the job site to manage the work safely and evaluate if additional oversight personnel are necessary.

- Evaluate all personnel at each job site to ensure that they have received training for the work being performed.

This event underscores the importance of an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. In this event, subcontractor employees were told to stop work several times. Ignoring these instructions, they continued work without any approval or guidance, resulting in their removal from the site. Strong actions and corrective actions such as those taken in this event are sometimes necessary when personnel refuse to comply with basic safety rules. These actions should prevent similar events.

Personnel at DOE facilities should have a continually questioning attitude toward safety issues. Each individual is ultimately responsible for complying with rules to ensure personal safety. Facility managers should communicate the idea that safety is of prime importance and that all personnel must be committed to excellence and professionalism. Worker training should emphasize that a change in work methods or equipment, or any other deviation from work instructions, can introduce unforeseen hazards. Any change to work instructions should entail a work stoppage and a review of the potential hazards associated with the change. Workers should also be trained to stop work and report as-found conditions that are inconsistent with expected conditions.

Personnel at DOE facilities are required to follow established work control programs without exception. Facility managers, work planners, and crafts personnel should review the following references, which provide guidance and good practices for implementing work control plans.

- DOE O 4330.4B, *Maintenance Management Program,* provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. It states that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events. The Order states that nonfacility contractor and subcontractor personnel should be trained and qualified for the work they are to perform. It also states that subcontractor personnel should perform work to the same high standards expected of facility personnel and that subcontractor managers should be held accountable for the work performance of their personnel.

- DOE-STD-1053-93, *Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities*, provides extensive guidance for the development of work control plans and the supervision of maintenance activities.

Integrated safety management information can be found at http://tis-nt.eh.doe.gov/ism. DOE technical standards are at http://www.doe.gov/html/techstds/standard/standard.html.

KEYWORDS: work planning, construction, contractor controls

FUNCTIONAL AREAS: Work Planning, Industrial Safety, Lessons Learned

3. FUEL STORAGE ERROR AT IDAHO

On March 9, 1999, at the Idaho Nuclear Technology and Engineering Center Fuel Storage Area, operators failed to store a fuel assembly in the storage port that was specified on a fuel receipt and transfer record form during cask unloading operations. After they had stored the fuel, the operators recognized their error. Operating crew personnel determined that the storage port the fuel was placed into was approved to store that type of fuel and that no criticality hazard or technical standard violation resulted. They also determined that because no hazard existed the fuel assembly did not have to be moved from its incorrect location. However, a number of conduct of operations procedural violations led the operators to store the fuel in the wrong location. This event is significant because operators violated conduct of operations procedures and because it could have resulted in a criticality safety violation or an unreviewed safety question. (ORPS Report ID--LITC-FUELRCSTR-1999-0005)

Investigators determined that two different crews of operators, with a common supervisor, performed the cask unloading operations. The second crew mistakenly used a fuel receipt and transfer record form that was intended for a different fuel unit, which was also being transferred. The operators involved discovered that they had used the wrong form after they exited the fuel storage area and were reviewing the record copy.

The facility manager held a critique of this event. Critique members learned that conduct of operations deficiencies, including an inadequate pre-job briefing, inadequate turnover of responsibilities, and poor communications, all contributed to this event. Specifically, (1) the second operator crew received an inadequate pre-job briefing and shift turnover when operators were changed in the middle of the cask unloading operation, (2) repeat backs to verify the actual port numbers before placing the fuel in a storage port were inadequate, and (3) operations personnel used the wrong fuel handling document because different fuel handling documents, for several different pieces of fuel, were present in the area. The facility manager recommended that standard practice prohibit the presence of more than one fuel-handling document at a time to prevent confusion. He also issued a lessons learned from the event and directed operations personnel to post it for operators' review.

NFS reported similar conduct of operations issues at Idaho in several Weekly Summaries. Some examples follow.

- Weekly Summary 97-11 reported that fuel handlers inadvertently lifted the Advanced Test Reactor cask insert and several fuel elements, causing an unreviewed safety question. When one of the fuel elements was lifted and about to clear the top of the cask, a fuel-handling supervisor noticed the cask insert had also been lifted. (ORPS Report ID--LITC-FUELRCSTR-1997-0002)

- Weekly Summary 95-44 reported that operators violated a technical standard when they failed to verify the identity of a fuel storage canister before moving it. As a result, they retrieved the wrong canister. (ORPS Report ID--LITC-FUELRCSTR-1995-0012)

These events underscore the need to ensure complete, positive control during fuel handling. The responsibility for ensuring adequate planning and control of work activities resides with line managers. Facility managers and supervisors should ensure that plan-of-the-day meetings or pre-job briefings are conducted and that they cover personnel responsibilities and the expectation that tasks are understood and procedures followed. They should also monitor activities by performing frequent direct observations of specific activities and routine walk-downs. This is especially important when fuel-handling issues are involved.

- DOE O 5480.19, *Guidelines for the Conduct of Operations Requirements for DOE Facilities*, provides guidance on sound operating practices and invokes several ANS standards for nuclear criticality safety programs. It states that accurate communications are essential for safe and efficient facility operation. Chapter VIII, “Control of Equipment and System Status,” states that the operating shift should know the status of equipment and systems, and it discusses the communications needed to maintain proper configuration control. Chapter X, “Independent Verification,” discusses which components require independent verification.

- DOE/EH-0502, Safety Notice 95-02, *Independent Verification and Self-Checking*, describes a technique that requires workers to (1) stop before performing the task in order to eliminate distractions and identify the correct component; (2) think about the task, the expected response, and actions required if that response does not occur; (3) reconfirm the correct component and perform the function; and (4) review the task by comparing the actual and the expected responses. Safety Notice 95-02 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874.

KEYWORDS: fuel handling, corrosion, canister, lessons learned

FUNCTIONAL AREAS: Operations, Nuclear/Criticality Safety, Materials Handling/Storage, Lessons Learned

4. NUCLEAR REGULATORY COMMISSION REPORT ON GASEOUS DIFFUSION PLANT FIRE

This week OEAF engineers reviewed the Nuclear Regulatory Commission’s (NRC) Augmented Inspection Team report on the December 9, 1998, fire in a side purge cascade (SPC) cell at the Portsmouth Gaseous Diffusion Plant. The Portsmouth plant uses the gaseous diffusion method to enrich natural uranium used as nuclear fuel for reactors. Inspectors determined that the immediate safety consequences of the fire were minimal because of the prompt response by facility personnel and firefighters to protect site personnel and the public. However, they identified problems associated with (1) the training of the operators and their immediate actions, (2) planning and training provided for firefighting staff, (3) procedures for implementing the emergency plan and training provided for some management staff, and (4) the timeliness and completeness of some of the initial compensatory and corrective measures implemented following the fire. Inspectors concluded that the initial efforts by facility investigators to determine the root causes of the event were appropriate but that the corrective measures recommended following previous similar events may not have been fully implemented. (NRC Region III Augmented Inspection Team Review of the December 9, 1998, Fire at the Portsmouth Gaseous Diffusion Plant, Report No. 070-7002/98019; NRC Event No. 35132; ORPS Report ORO--BJC-PORTENVRES-1998-0020)

On December 9, 1998, operators observed abnormal conditions associated with the first cell of the SPC during routine operations. The SPC is an interconnected arrangement of low- and high-speed motors, compressors, and converters that separates low molecular weight (light) gases from the process gas (uranium hexafluoride) and vents the light gases to atmosphere. The operators' immediate response to the abnormal conditions was not successful and an exothermic reaction propagated within the cascade. The reaction continued until sufficient heat was generated to cause a failure of the cell cooling system, initiating a second exothermic reaction. Subsequent heat and pressure increases within the cascade resulted in (1) the creation of holes within the process gas boundary of the cell, (2) automatic shutdown of the side purge cascade, (3) activation of an automatic fire suppression sprinkler system, (4) an emergency response that entailed 2 hours of firefighting by the on-site fire department, and (5) challenges to the continued operation of the remainder of the process gas cascade. A few operators inhaled smoke and some emergency responders incurred minor injuries when they slipped on spilled lubricating oil. They were treated at an on-site medical facility.

Firefighting efforts were complicated because (1) operators failed to isolate hydraulic control oil to the cell, (2) low fire water pressure to foam eductors prevented the use of foam as an extinguishing agent, and (3) the emergency responders' understanding of the proper techniques for fighting a fire when there are holes in the process gas equipment was weak. Weaknesses in the emergency plan implementing procedures were responsible for management not classifying the event as an "Alert" and not activating the emergency operations center. Some communications between the emergency responders and management were ineffective, with the result that management did not fully realize the scope and consequences of the fire until 6 hours after it was extinguished. Also, plant staff failed to notify local, state, and NRC officials during the emergency response.

NRC inspectors identified the following concerns.

- **Immediate Actions During and Following the Event** — The operators' initial response was not consistent with some plant procedures and may have allowed the abnormal condition to propagate. Subsequent actions were also not fully consistent with plant procedures and were partly responsible for the continued supply of hydraulic control oil to the cell throughout the fire. Some of the incident commander's emergency response activities were delayed or not fully implemented as a result of deficiencies in emergency procedures, pre-fire emergency packets, training for the firefighters, and communications with the plant's main control room. Management's initial response to the fire was inconsistent with the emergency plan, though consistent with the implementing procedures. The decision not to activate the emergency operations center and not to classify the fire as an "Alert" increased communication problems between the incident commander and other management personnel. As a result, the safety concerns related to holes in the piping and the 3,000 gallons of spilled oil were not promptly resolved.

- **Analysis of the Root Cause and Corrective Actions —** At first, the recovery team did not have clear objectives, they were not exclusively assigned to the recovery efforts, and they were not fully cognizant of the immediate consequences of the fire. As a result, some compensatory and corrective measures were not implemented in a timely manner.

- **Radiation, Chemical and Fire Protection —** The radiological and chemical consequences for on-site personnel were minor and there were no consequences for members of the public. However, some of the respirators were located outside the area control rooms, impeding their use, and the lack of detailed guidance in the pre-fire plan and emergency packet for the building hindered emergency responders in allocating resources and developing strategies for fighting the fire.

- **Consequences to Safety-Related and Other Plant Equipment —** The fire burned holes in the process gas piping and components, compromising their ability to act as a barrier to the release of process gases from the cascade and to the moderation of uranium deposits in the cascade. Other safety-related systems performed as expected.

- **Similar or Precursor Events —** The existing operational, maintenance, and failure analysis practices did not identify the potential for similar events, as there had been three earlier hot metal process gas reactions at the Paducah and Portsmouth plants. Corrective actions were developed from those events, but many were never fully implemented.

- **Impact of the Event on the Fire Suppression System Design Basis —** The fire protection sprinkler system design basis was adequate and the system was able to perform even though it was designed to control a lubricating oil fire outside a cell, not inside it. The system may be credited with controlling the fire until the fire department arrived. However, some previous recommendations for design changes to the sprinkler system may require reevaluation in light of the characteristics of a fire inside the process gas cascade. Although the fire department extinguished the fire in an adequate manner, additional reviews and training appear necessary to ensure that (1) a sufficient number of personnel are available to fight a similar fire during non-shift turnover periods, (2) proper equipment is available and personnel are trained to use foam to fight a cell floor fire, and (3) the firefighters understand the fire responses necessary to support the safety analysis evaluations.

- **Event Reporting Process and Notifications —** Inconsistencies between the emergency plan and the procedures for implementing it were one reason the plant staff did not promptly report the fire, which could have led to a release of radioactive materials, to local, state, or NRC officials.

Immediately following the event, the facility managers established an investigation team to determine the root and contributing causes of the event. The extensive fire damage to the equipment in the cell destroyed evidence and made it difficult to determine the root cause, and the investigation is continuing. However, investigators believe that the rubbing together of internal compressor parts most likely caused the exothermic reaction. The resulting friction could have generated enough heat to reach the melting point of aluminum. The molten aluminum then reacted chemically with the uranium hexafluoride (UF_6) process gas, generating additional heat. As the cell continued to operate, additional UF_6 fed the reaction and spread it to other stages. A gas cooler ruptured and released R-114 coolant into the cell. The release and expansion of this coolant increased the cell pressure and when the coolant reacted chemically with the aluminum, additional heat was generated. The high temperatures and, possibly, elevated pressure led to the destruction of converter tube bundles and the breach of the cell boundary.

Investigators also determined that the stage 2 and 4 compressors in the cell had been replaced three weeks before the event because of high vibration. When they examined the compressors, they found extensive first-stage impeller damage in the stage 4 compressor. The section in the safety analysis report that deals with the isolation of failures states that if the amp loading in a single stage begins increasing, the problem may have been triggered by compressor parts rubbing together, by deposits in the compressor, by bearing failure, or by some other failure associated with the motor, which requires immediate shutdown. The SPC operating procedure did not contain guidance to help the operator differentiate between load changes caused by controllable factors such as compressor surging and load changes caused by equipment failure, nor did it contain guidance on the type of amp increases that would necessitate a cell shutdown.

Facility managers implemented immediate corrective actions to address issues identified during the investigation. Longer term corrective actions are still being developed. Following are some of the immediate corrective actions.

- A training module was developed to teach the recognition of cell surging, cell loading, and cell shutdown requirements. Lessons learned were developed and issued to cascade personnel on the subject of operating conditions that may increase the risk of a similar exothermic reaction.

- Administrative controls were established to prevent returning the SPC to service in such a situation and to ensure that if a centrifugal compressor is shut down because of vibration it will not be restarted in the presence of UF_6.

- A vibration survey on running motors and compressors was conducted and weekly vibration surveys on operating purge cascade equipment were initiated. Ultrasonic inspection was performed on piping elbows in other side purge cells and no wall thinning was observed.

KEYWORDS: compressor, diffusion, enriched material, emergency, fire, fire protection, gaseous, operations, training and qualifications

FUNCTIONAL AREAS: Emergency Planning, Fire Protection, Operations, Training and Qualifications

5. CONSTRUCTION CONTRACTOR CUTS ARM WITH DISK GRINDER

On March 9, 1999, at Sandia National Laboratory—Albuquerque, a pipe fitter/welder employed by a construction contractor received a large gash on his left forearm from the blade of a grinder while grinding on temporary bracing at a construction site. The grinder blade got caught on the angle iron he was grinding and bounced into his forearm. An ambulance took the pipe fitter/welder to a local hospital, where medical personnel closed the wound with several sutures. The pipe fitter/welder used the grinder without the factory-supplied blade guard, which was in violation of OSHA standards. The risk of severe injury can be reduced by using established barriers to prevent workers from coming in contact with rotating hazardous parts. (ORPS Report ALO-KO-SNL-7000-1999-0001)

The grinder was an electric handheld portable grinder that was relatively new. Investigators examined it and noticed that the blade used on it was in poor condition. They also determined that the pipe fitter/welder had picked up the grinder from the shop without the safety guard installed. He also used the wrong type of blade and should have had a cutting blade rather than a grinding blade.

Another event involving a missing blade guard occurred at Sandia National Laboratory—Albuquerque. On November 24, 1998, a worker severed his left thumb while cutting plywood on a table saw. He was removing a strip of scrap wood with his hand while the saw was operating. Investigators determined that the furnished blade guard, which included the kerf splitter and antikickback dogs, had been removed from the saw shortly after it was purchased. They also determined that the saw was not included in the facilities qualification and control system and that personnel were not knowledgeable about safe table saw operations. The blade height was not adjusted properly; the saw fence drifted, resulting in incorrect board dimensions and necessitating recutting and trimming; a push stick was not used to remove scrap wood; and power to the saw was left on during scrap removal. (ORPS Report ALO-KO-SNL-6000-1998-0005)

NFS reported the following two events in the Weekly Summary that involved accidents with rotating tools.

- Weekly Summary 99-05 reported that a grinding wheel on a handheld pneumatic grinder disintegrated while a pipe fitter was grinding slag from a metal plate at the Hanford Site. The guard of the grinder protected the pipe fitter and deflected the broken pieces toward the floor. The largest segment traveled 15 feet and struck a metal garbage can, penetrating one side of the can and propelling it 15 feet. Other fragments were distributed over a 12-foot radius. Investigators determined that the grinding stone was rated for up to 6,000 rpm and that the grinder was rated for 7,700 rpm. (ORPS Report RL--PHMC-FSS-1999-0006)

- Weekly Summary 93-02 reported that a worker at the Lawrence Livermore National Laboratory severed the small and ring fingers of his left hand while cleaning and inspecting a rotating grinding wheel and cutting blade. He inadvertently placed his hand in a position such that the rotating wheel pulled his fingers and pinched them with the knife-edge. Investigators determined that the normal operating practice required the blade to be backed away from the grinder before inspection. Also, machine guards did not fully cover the blade/grinding wheel area. Both fingers were reattached at a local hospital. (ORPS Report SAN--LLNL-LLNL-1993-0001)

OEAF engineers reviewed the following events reported in OPRS. These events illustrate the dangers associated with high-speed rotating equipment.

- A machinist at Sandia National Laboratory—Livermore sustained four superficial cuts and damage to the nerve bundle of his left hand when he reached underneath a guard on an operating lathe with pliers to remove some tailings. The lathe chuck struck the pliers and his left hand, resulting in the injury. (ORPS Report ALO-KO-SNL-CASITE-1996-0002)
- A sheet-metal worker at the Hanford Site cut an artery when the portable grinder he was using kicked back and cut his unprotected wrist. He should have been wearing Kevlar® gloves to protect the arm and wrist area. (ORPS Report RL--KEH-KEH-1993-0025)
- A DOE facility representative at the Hanford Site discovered a 6-inch bench grinder that did not have the necessary safety guards in place. One guard was missing and the other was significantly out of alignment. (ORPS Report RL--WHC-SNF-1992-0014)

These events underscore the importance of ensuring that all machine tool equipment and portable tools are inspected and evaluated for compliance with OSHA safety standards. Facilities should provide employees who operate and maintain these tools with the necessary training and up-to-date procedures or instructions that address safety hazards. Workers should keep safety guards in place and ensure they are in working order, properly adjusted, and never removed when the tool is being used.

The following references provide safety-related information on grinding and cutoff wheels and tools.

- 29 CFR 1910.243, *Guarding of Portable Power Tools*, and 29 CFR 1910.215, *Abrasive Wheel Machinery*, state that a safety guard shall cover the spindle end and the nut and flange projections. The safety guard shall be mounted so as to maintain proper alignment with the wheel, and the strength of the fastenings shall exceed the strength of the guard.
- 29 CFR 1926.300, *General Requirements*, states that when power tools are designed to accommodate guards they shall be equipped with such guards when in use.
- 29 CFR 1926.303, *Abrasive Wheels and Tools*, states that grinding machines shall be equipped with safety guards in conformance with the requirements of the American National Standards Institute, B7.1-1970, *Safety Code for the Use, Care and Protection of Abrasive Wheels*.
- ANSI B7.1-1970, *Safety Code for the Use, Care and Protection of Abrasive Wheels*, states that after the wheel has been mounted and before starting the wheel, the safety guard shall be secured in place. The safety guard shall be inspected for condition and adjustment. All safety guard fasteners shall be in place and properly tightened.

KEYWORDS: grinding, industrial safety

FUNCTIONAL AREAS: Industrial Safety

6. BRIDGE CRANE WIRE ROPE DAMAGED

On February 24, 1999, at the Hanford Reprocessing Facility, the wire rope on a 10-ton bridge crane was damaged when the load shifted. Crane operators were moving equipment being size-reduced as part of facility deactivation when the load became entangled with other equipment. Operators used the bridge crane to attempt to dislodge the load. When the load dislodged, the resultant shifting caused a momentary slack-rope condition and the rope was damaged when it became entangled on the winding drum. Failure to adequately control hoisting practices resulted in damage to equipment and delays to facility operations. (ORPS Report RL--PHMC-324FAC-1999-0004)

When the load became entangled, crane operators attempted to dislodge it by using various combinations of bridging, trolleying, and hoisting. Investigators determined that facility hoisting and rigging procedures were inadequate to control this practice (side pulling). Side pulling refers to using cranes, which are designed to be loaded in the vertical direction, to apply a force with a horizontal component. They also determined that shift turnover was inadequate because oncoming shift operators were not completely aware of the configuration of the equipment and how it should have been lifted. After operators observed the slack-rope condition, they stopped work and inspected the winding drum. When they observed that the wire rope was incorrectly wrapped on the drum, they bridged the load to a safe location, laid it down, and disengaged the hook from the load. The facility manager initiated a work package to replace the wire rope. Planned corrective actions include developing guidelines and restrictions for the crane operating envelope and developing and implementing actions to improve shift communications.

OEAF engineers searched the ORPS database and found one similar event. On August 26, 1997, at the Savannah River Site F-Canyon Facility, a crane process operator was raising an unloaded monorail hook when the wire rope parted. Inspectors determined that the cause of failure was misspooling of the wire rope on the drum. They also determined that the most likely cause of this condition was the use of the hoist to pull at an angle, i.e., a side pull. (ORPS Report SR--WSRC–FCAN-1997-0031)

This event underscores the importance of operators and planners understanding the fundamentals of hoisting and rigging and having and using well-developed crane operating envelopes. Work planners must analyze the stability of the crane and the structural integrity of the crane's load-bearing parts before using a crane for side pulls. This event also underscores the importance of conducting an adequate shift turnover. The following references provide guidance on safe crane operations and shift turnover.

- DOE-STD-1090-96, Revision 1, *Hoisting and Rigging*, chapter 7, specifies operation, inspection, maintenance, and testing requirements for the use of overhead and gantry cranes and implements the requirements of ASME B30.2, *Overhead and Gantry Cranes.* The standard states that the person appointed to direct the lift shall note that the load does not contact any obstructions. It also states that cranes shall not be used for side pulls except when specifically authorized by an appointed person who has determined that the stability of the crane is not endangered and that its load-bearing parts will not be overstressed. These same requirements are also outlined in 29 CFR 1910.179, *Overhead and Gantry Cranes.*

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter XII, "Operations Turnover," states that shift turnover is a critical part of DOE facility operations. The Order also states that on-coming personnel should not assume operational duties until both they and the off-going personnel have a high degree of confidence that an appropriate information transfer has taken place. On-coming personnel should conduct a comprehensive review of appropriate written information (logs, records) and visual information (equipment, control boards) before responsibility for the shift is transferred to them. Shift turnovers should be guided by a checklist and should include a thorough review of the documents describing important aspects of facility status and an inspection of the relevant facility instrumentation.

- DOE-STD 1038-93, *Guide to Good Practices for Operations Turnover*, states that operations turnover practices are one element of an effective conduct of operations program and that effective turnovers are crucial to the safety of DOE facilities. The turnover process should ensure that on-coming personnel have an accurate picture of facility status and that past and scheduled operations are reviewed. Briefings conducted near the end of each shift enhance shift turnover and operator awareness of plant status and identify needed follow-up actions. Operators involved in these briefings are informed and prepared to conduct a more thorough shift turnover.

- DOE-STD-1031-92, *Guide to Good Practices for Communications*, discusses the need for clear, formal, and disciplined communications and provides guides for improving communications.

- DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, provides information on work controls and work coordination.

KEYWORDS: communication, deactivation, hoisting and rigging, work planning

FUNCTIONAL AREAS: Hoisting and Rigging, Work Planning

OEAF FOLLOW-UP ACTIVITY

1. CLARIFICATION TO WEEKLY SUMMARY 99-09, ARTICLE 7

Feedback from a Weekly Summary reader calls for clarification of Weekly Summary 99-09, Article 7, “Employee Sprayed with Acid,” with respect to the acid chemical reaction and the failure to use a safety shower. In that article, it was reported that the cause of the chemical reaction was mixing of concentrated hydrochloric acid (HCl) and concentrated sulfuric acid (H_2SO_4). The HCl was concentrated to between 35 and 37 percent (63 to 65 weight-percent water) and the H_2SO_4 was concentrated to between 92 and 96 (4 to 8 weight-percent water). The high-water-content HCl added to the low-water-content H_2SO_4 resulted in an exothermic reaction that caused the acid to spray onto the employee. The usual response when harmful chemicals have been spilled or splashed on the body is to first remove them by flooding the exposed area with running water from a safety shower, and then remove any contaminated articles. If eye exposure occurs, an eyewash fountain should also be immediately used to flush the eye and eyelid with water for 15 minutes. In this event, no eye exposure occurred. Because the acid infiltrated beneath his hood, the employee chose to doff the acid-contaminated respirator and hood first, and then to flush the affected area with an eyewash instead of the available safety shower.

KEYWORDS: acid, chemical reaction, eye wash, hazardous material, injury, occupational safety, shower

FUNCTIONAL AREAS: Industrial Safety, Material Handling/Storage